DOCUMENT RESUME

ED 343 675 PS 020 380

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TITLE Implementing Thinking in the School's Curriculum.
PUB DATE 9 Feb 92
NOTE 58p.; Paper presented at the Annual Meeting of the International Association for Cognitive Education (3rd, Riverside, CA, February 9, 1992).
PUB TYPE Speeches/Conference Papers (150) -- Information Analyses (070)

EDRS PRICE MF01/PC03 Plus Postage.
DESCRIPTORS *Cognitive Development; Computer Assisted Instruction; *Curriculum Development; Elementary Education; *Learning Processes; *Learning Theories; Models; Program Descriptions; Teaching Methods; Theory Practice Relationship; *Thinking Skills

ABSTRACT

The teaching of thinking has become the focus of a new interventionist paradigm in schooling. Four perspectives have been particularly influential in the development of the paradigm: (1) the cognitive view of intelligence, which asserts that intellectual ability can be changed; (2) the constructivist approach to learning, which maintains that children actively and independently construct knowledge by creating and coordinating relationships in their mental repertoire; (3) the social psychology view of classroom experience, which focuses on the learner as an individual who is a member of various peer groups and a society; and (4) the perspective of information processing, which deals with the acquisition, elaboration, and management of information. Three exemplary teaching strategies can be linked to these research perspectives: Reuven Feuerstein's instrumental enrichment program involving mediated learning experiences and psychological intervention; Stanley Pogrow's higher order thinking skills program, which includes computer-based instruction in information processing skills; and Robert Slavin's two cooperative learning programs for math and language arts. All three strategies include staff development components. Schools can facilitate the implementation of thinking programs by attending to six critical factors: clarity of objectives, importance of environment, staff development and program support, incentives for involvement, timing and ownership, and stable leadership. A reference list contains 69 citations. (AC)

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IMPLEMENTING THINKING IN THE SCHOOL'S CURRICULUM

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a paper presented at

International Association for Cognitive Education

Third Annual Meeting

University of California at Riverside

Riverside, CA

February 9, 1992

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INTRODUCTION

For the past thirty years, schooling around the globe has witnessed a gradual recognition that a social-cognitive approach to teaching and learning is a more effective paradigm for education in the modern world than the traditional methods of fact accumulation. In Europe, researchers in Britain, Switzerland, France, Germany, Holland, and Belgium have examined the development of the child, the nature of human intelligence, and the instruction of complex mental operations as important aspects or issues that ought to underlie policy setting in education (Nisbet & McGuinness, 1990).

In America, the decline of a behavioristic psychology has gradually given way to an appreciation that consciousness and culture are important factors of human development and understanding, that both formal and informal settings can be instructive and formative, and that human motivation and personal commitment are powerful influences on any given individual's accomplishments (Gardner, 1985). It was in such a setting that a "movement" to teach thinking to every student, to develop the learning potential of every child, began (Brandt, 1988). How has this movement been carried out and what has been learned from its implementation?

It is not difficult to understand the varied and troubling conditions that led educators to look for better ways to help students learn to think. Lower test scores, global economic competition, a rapidly growing

technological base in the workplace, increased immigration, and changing demographics are just some of the problems that face educators who are trying to prepare workers for life and jobs in a new century (Carnevale, 1991). But with the increased demands of a multiple literacy schoolhouse, with an information revolution that constantly creates enormous information resources, the goals of education have also shifted. Some even suggest that a new paradigm for education has come into being (Presseisen et al, 1990).

At the end of this century, the vision of the school as a learning community has emerged and with it the desire to create a thoughtful classroom and a cognitive curriculum (Resnick & Klopfer, 1989; Udall & Daniels, 1991). In this restructured schoolhouse, the teacher is seen as a facilitator of knowledge use and reflection; the student as a developing, autonomous learner who needs to mature mentally in the few short years of formal education, so as to be prepared for a lifetime of change and learning. Teaching thinking -- building competence and sophisticated, self-regulative patterns of thought -- has become the focus of a "cognitive revolution" in schooling (Presseisen, 1985). Such teaching, at the heart of the school's program, has created a major challenge for educational practice. It has forged the problem of an interventionist education for cognitive ends and raised multiple questions about both why and how to achieve these new goals.

Are there programs that will bring about the desired changes of the new interventionist model? If there are, how can schools support and facilitate the implementation of these efforts? These are the major concerns of this study. To begin, let us first reflect on how this new paradigm for education actually came about. How did teaching thinking become a legitimate and conscious effort in both American and European schooling?

THE DEVELOPMENT OF ADVOCACY FOR INTERVENTION

Teaching thinking and plotting a purposeful path in education that includes conscious thought development did not come about overnight. These are outcomes of several decades of psychological and sociological research on questions related to the change or progress that all successful learners manifest as they become more sophisticated thinkers. Obviously, between entering school and graduation, students change dramatically. Under more careful examination, one sees that children's intellectual development results from many activities and is genuinely as astounding as their physical growth.

What mechanisms account for mental change in youngsters and what role does schooling play in the transformations that influence the very thinking of the learner? In what ways might the student's day-to-day experiences either enhance or constrain learning as youngsters seek to become more skillful thinkers? These are the questions that confront the cognitive revolution in schooling. They form the foundations of the so-called "teaching thinking movement."

By examining the psychological research literature of nearly half a century and defining the historic issues behind these key questions, one may better understand the various aspects of advocacy that are represented by the several speakers at this conference. To some degree, the Piagetian vision of learning and development formed the first awareness of the child's psyche in the classroom (Schwebel & Raph, 1973; Isaacs, 1974; Furth & Wachs, 1974). Findings from Genevan observations shaped many concepts that opened the teaching process to a thoughtful and research-based discussion about cognitive change. For example, Piaget-inspired psychology focused on three

major concepts of development to describe regular change in a learner's intellectual viewpoint: sequence, synchrony, and constraint (Fischer & Bullock, 1981). Developmental sequences are relatively common in child development. Piaget (1970) himself noted scores of sequences in the child's conception of the physical world such as "object permanence," "conservation," "seriation," and "classification." Various researchers have specified sequences in other domains, such as science or mathematics (Gelman, 1991). Synchrony refers to the appearance of two or more traits at the same time, where no specific pattern or sequence appears to be operating.

The notion that a hierarchy of thinking might provide the underpinnings of a child's overall cognitive development is one of the implications of the concept of developmental sequence. More complex cognitive structures or processes can be thought to be composed of less complex constituents. For example, in sorting nouns and verbs on a list of new vocabulary words -- say in reading or foreign language -- the cognitive process of classifying can be characterized as comprised of the less complex ability to sort nouns alone, as well as the skill to discriminate among verbs. Further, for a given group of students, it might be expected that usually simpler tasks are learned earlier and more complex structures later on in instruction. Sometimes, a systematic bias may operate on a sequence -- as when young children appear to classify by shape before they classify by color. And, under certain circumstances, opportunity can even influence the sequence of learning. Given more exposure to a particular task, or additional practice at performing it -- perhaps with more challenging materials -- it appears that some youngsters can develop a particular ability earlier in a learning sequence than others. Still other cognitive skills in a young learner's

repertoire may be influenced by the level of maturity of the individual or the occurrence of a particular physiological change, like puberty.

Kinds of synchrony in learning introduce educational concerns such as the potential levels of development in students. Specifically, the notion of synchrony raises issues like "the matter of degree," how much work ought a child concentrate on to get performance to a particular level of mastery, and even the question of what is mastery itself? There is also the issue of what other factors appear as a particular processing change occurs, such as the ability to focus or concentrate one's efforts. Are there additional characteristics of learning that help or hinder students as they seek to improve their thinking ability? What about time for reflection or comparison with what is already known? These factors may not have a direct influence on learning in a particular sequence or about specific content, but they may well be associated with the development of overall learning characteristics and thus be of synchronous concern in teaching thinking.

The research related to the Genevan school's findings, and to the work of their conceptual followers, suggests that a student's cognitive development is not a simple matter, that human behavior is complex and develops with many change aspects operating simultaneously. Early developmental research also raised several basic questions that became central to the study of how to enhance the thinking of an individual child or of children in particular groups. These include:

- Of what importance is the child's ability <u>to change</u> his/her ways of thinking?
- Are there <u>limits</u> to learning in a particular sequence of development?
- Are there <u>optimal levels</u> of learning that can be established for a

given population, in particular content areas, or at specific times of development in a student's intellectual life?

These are some of the most significant issues that pre-dated interventionist strategies for teaching thinking. They are the kinds of questions around which key developments in psychological research wrangled for decades. At least four important frameworks or approaches to children's cognitive development emerged in response to these queries. To understand better the cognitive revolution of which teaching thinking today is a part, these frameworks are worthy of more detailed discussion. The frameworks include: the cognitive view of intelligence, the constructivist approach to learning, the social psychological view of classroom experience, and the information processing perspective on knowledge development.

The Cognitive View of Intelligence

Cognitive psychologists approach the concept of intelligence very differently from psychometric or biologically based theorists who believe intellectual ability is innate and can be altered only in terms of speed of performance. Sternberg and Wagner (1982) maintain that Binet in France and Terman in the United States sought to understand intelligence by analyzing the increasing ability of children to solve relatively complex problems, but they chose an incorrect construct -- mental age -- around which to build their analysis. Mental age "may describe increases in level of intelligence on intellectual tasks," the American researchers say, but the construct "does not explain them" (p. 4).

The factor analysis model advocated by other psychometric researchers appears no more successful in explaining the transition between one level of a child's performance and another. It seems, from the viewpoint of cognitive theory, there needs to be some internal mechanism or set of

developing operations that make possible the various processes one sees in successful learning (Miller, 1989). While the multiple factor model originally presented by researchers like Guilford provided a more adequate description of intelligent behavior than a static biological approach, the questions of origin and cause of developing sophistication still were largely unanswered by that model.

At the heart of the cognitive view of development is the assertion that intellectual ability can be changed (Feuerstein, 1990). Also central to this view are the relationships of prior knowledge and creativity to the development of rational understanding. That is, rational thinking seems to be fostered by enhancing and adding to one's existing knowledge base in creative, meaningful ways. All the various aspects of mental mechanisms may not yet be fully understood, but it is proposed, through both accumulation and enrichment, that their ultimate formation in the development of intelligence can be influenced (Detterman & Sternberg, 1982). Malleability of human performance is at the core of the cognitivist's developmental view, casting suspicion on more simplistic, static, and psychometric notions of intelligence. With regard to teaching thinking in the classroom, such instruction becomes the major vehicle for influencing change in the intellectual capability of the student. Now, in fact, such an instructional goal seems to define anew what it means to learn, and it reformulates, at the same time, the role of teacher in the classroom.

The Constructivist Approach to Learning

The seminal work of Piaget and his colleagues in Geneva was based on the questions of why successful students perform as they do and what are the cognitive structures that underlie their behavior. Through repeated observations of children's performance, and particularly their errors in

reasoning, Piaget (1963) concluded there are universal logical structures that direct children's thinking. He further maintained that adult thinking and that of children are quite different, and he went on to identify a series of stages of thought development that parallel, or actually explain, the transitions from child-like thinking to the more sophisticated thoughtfulness of the adult.

The four stages of thinking characterized by Piaget are sensori-motor, pre-operational, concrete operational, and formal operational thought. Each stage identifies a major change in the child's ability to represent and interact with the world. The sensori-motor child in a toddler state relies on physical contact with the world to understand the immediate surroundings. This youngster touches the objects of his/her environment, follows carefully sound and sight impulses, and "knows" existence through his/her direct means of experience.

The next of Piaget's stages explains the world of the young child as one dominated by his/her own centralized view of existence. By and large, children initially entering school in nursery or kindergarten years are primarily pre-operational in thought; they are dominated by their egocentric perceptions. Gradually, from concrete experiences, youngsters develop more discrete understandings and then build more powerful explanations of their immediate world (Elkind, 1976). They learn to label objects with names and they learn to categorize phenomena into particular groups -- their mental representations begin to take on reflective and conceptual meanings.

Abstractions and mental complexity slowly begin to appear to the young thinker, as experience broadens and new generalizations are tested through real world applications. By their early teens, most students develop the ability to perform higher forms of cognitive operations often associated

with critical and creative thinking, complex rational thought processes, and problem solving. Gradually, learners become adept at applying formal operational concepts to the world around them; they become both predictive and more insightful (Piaget, 1976).

Piaget's stage theory was not meant to be an immutable, locked-in sequence. It is unfortunate that some researchers suggested that is what he proposed -- and then sought to criticize his conception for that. Rather, it is more productive to think of Piaget's approach to learning within a constructivist interpretation; when students try to solve a problem with a particular strategy, they learn the nature of the real problem and aspects of it that need to be resolved; successful learners then shape new or additional information interactively with their working strategy until they are able to resolve the specific task. In short, learners actually build their own skilled intelligence by revising their explanative strategies and by taking on more complex routines. They benefit from the cognitive experience of "having wonderful ideas" (Duckworth, 1987). Such creative and self-regulated learning is at the heart of Piaget's equilibration theory and, according to Kamii (1984), is directly related to the Swiss epistemologist's notion of learner autonomy as the major aim of education.

Thus, the cognitivist approach to learning maintains that children actively and independently construct knowledge by creating and coordinating relationships in their own mental repertoire. This activity is paralleled in the various learning environments of a student's life. Whereas biological and psychological endowments may play an important role in a particular child's ability to perform in a classroom, it is his/her potential for changing incorrect or inadequate interpretations -- through the instructional situation -- that ultimately influences the phenomenon of

learning. The constructivists share with cognitive theorists in general the belief that a child's intellectual ability is more complex than once viewed biologically. They also take the position that social exchanges and new awarenesses provoked and dealt with pedagogically in the classroom can significantly influence each child's intellectual development.

The Social Psychological View of Classroom Experience

A third framework derived from research literature of the past two or three decades comes from social psychology and focuses on the learner as an individual within various cohorts or peer groups, as well as a member of the larger society itself. Life span researchers emphasize the importance of the continuity of thinking process development through a person's lifetime (Elder, 1980). The particular "ages" of social development -- infancy, childhood, adolescence, adulthood, and old age -- are discussed as influences, if not templates, that determine the learner's changing perspective and build operating links to ongoing life experience. In addition, recent research has begun to examine the significance of cognitive change within cultural and cross-cultural contexts. Feuerstein (1990), for example, paralleling Vygotsky, discusses the importance of a learner's bonds to his/her own cultural identity and the significance of intellectual exchange that takes place from one generation to the next.

In this context, the role that other persons play in the student's own tuition -- considering the input of parents, teachers, caregivers, peers -- forms the basis for a lifelong dialogue for learning, created by social interaction. In the same vein, Paul (1987) proposes that such a dialogical model of learning is the key to developing the critical thinking abilities so sorely needed today in the school's program. Similarly, in Gardner's (1983) multiple views of intelligence, two of the seven forms of

intelligence he describes are social in nature, one directed inward and the second defined by interaction with others.

The importance of the classroom as a community for learning is part of the social psychological perspective. Cognitive researchers like Bruner (1960) and Elkind (1979) have long praised the merits of communal human interaction in learning situations and highlighted the singular significance of a mediational relationship between the teacher and pupil. Their position is reminiscent today of the way Bronfenbrenner (1991) characterizes the kind of connection that needs to exist between parent and child -- a strong, mutual, irrational, emotional attachment -- for intellectual, emotional, social, and moral growth in the child to take place. The construct of a "learning environment" is an important concept on the road to intervention. Environment is more than mere surroundings or the "climate" of a classroom. A learning environment amply provides social opportunities for instruction and, when mutual and reciprocal, for learning. Such an environment includes provocative information, but also feelings, dispositions, and lively models of cognitive strategizing. It is a qualitative locale, a nurturing, mediating, and mind-expanding exploratorium.

The Perspective of Information Processing

The last viewpoint on cognitive change in youngsters deals with the acquisition, elaboration, and management of information. In a world filled with many ideas and sources of data, how a learner meets such "input," relates it to what he/she already knows, and then "stores" it for retrieval at another time or place, involves an information processing perspective. In terms of the changing paradigm in education, one could say that instead of merely accumulating information for coverage, the learner today is confronted with the two-sided problem of recalling important facts or

concepts and knowing what to do with this information once it is part of working memory. As Bransford and his colleagues (1986) argue, there are dangers to inert knowledge as understood by Whitehead. Such information can be accesssed only in a restricted set of contexts, even though it is applicable to a much wider variety of domains. The educational problem is how to get such limited information focussed upon and used expansively by the thoughtful learner.

The information processing approach to cognitive development is often concerned with brain mechanisms, including issues related to memory, perception, and rules regarding information integration and synthesis. Miller (1989) names seven basic cognitive processes -- perception, attention, learning, memory, reasoning, language, and emotion -- which are, in turn, tied to neuroscientific studies of the brain. It is known that some mental processing is automatic while other operations are planned and involve decision making. Recent brain anatomy research suggests that several careful experiments show how animals' brains have actually been changed by providing them enriched environments (Diamond, 1988).

One of the most significant problems in processing information in a data-filled world is how to sort incoming data, to form flexible but meaningful conceptions, and to tie these to other sets of related data. As the curriculum becomes enlarged with burgeoning subject matters, this networking problem becomes even more demanding. Teaching thinking is often concerned with "assimilating" and "accommodating" information, the original Piagetian conception; with creating thinking "frames," the mental organizers referred to by Perkins and Salomon (1988), especially for transfer possibilities; and with building web-like connections that ultimately help the learner "go beyond" specific information to things that are related to,

but sometimes imaginatively different from, the original information (Bruner, 1964).

It is not surprising that the information processing approach to cognitive development often involves the use of computer technology in classroom applications of teaching thinking. Some researchers see electronic learning environments as a revolutionary tool for transforming classroom instruction (Brown, 1985; Shavelson & Salomon,1985). Certainly, the computer raises the issue of varying modalities through which information enters a student's consciousness. In the new paradigm for education, one may find information in print, as verbal material has been coded for centuries in schools; but video technologies are also a growing influence on the learning of youngsters in today's world. Linguistic, musical, logical-mathematical, spatial, and bodily-kinesthetic intelligences are common to every human being, in addition to the personal, social abilities, says Gardner (1983). The cognitive revolution in teaching thinking may suggest that schooling pay attention to all the modes by means of which information can be experienced in student learning.

Summary

The first part of this study places the teaching of thinking and the deliberate cognitive development of students in an historic perspective. Advocacy for including a major focus on thought development in the school's program does not stem from a simple nor a shallow past. Key questions and at least four major perspectives within a research-rich experience have brought a new interventionist paradigm for education into consideration. The second part of this study will examine a sample of actual practices of teaching thinking in the classroom, as related to these perspectives, over the last decade.

THINKING IN THE CLASSROOM

Various interventionist programs and practices regarding teaching thinking have been introduced in schools in the United States over the past twenty to twenty-five years. These efforts are most often associated with rather specific objectives related to teaching thinking. They also tend to be related to projects that are led by particular researchers or scholars who have developed the materials and, in some cases, training programs for practitioners who are to use the curricular materials.

A review of teaching thinking materials available to educators in America finds there are as many as thirty "programs" that a school or school district can obtain to help their student populations become better thinkers (Kruse & Presseisen, 1987). Several of these programs are the "old timers" of teaching thinking efforts and are reviewed in all the catalogues and studies of interventionist cognitive instruction (Chance, 1986; Costa, 1985; Banks, 1991). These include de Bono's CoRT, Feuerstein's Instrumental Enrichment, and Lipman's Philosophy for Children programs. The other programs that are included in such listings depend on the author of the listing and, to some extent, on a less than thorough collection of either descriptive or evaluative information about the teaching thinking materials. A great deal depends on what is considered a bona fide program for teaching thinking, what key components are comprised in such an effort, and how such a program is expected to relate to a school's curriculum.

Beyer (1988) considers at least five aspects that need to be present to consider a teaching thinking program beneficial. Four of them concern the students: (1) the program helps students to become more effective, skillful

thinkers; (2) the program can improve student achievement in academic and other school subjects; (3) the program can help students develop more positive self-concepts and attain achievements both in and out of school; and (4) the program can help students develop those habits and abilities of thinking that are required for effective citizenship. The fifth aspect Beyer proposes is that teachers will be benefitted, too. The program to teach thinking will "raise the level of discourse in the classroom" and enrich the act of teaching and the minds of the teachers as much as that of the students (p. xiv).

Kanach (1989) reports that a state-sponsored technical assistance workshop on teaching thinking uses a six-component evaluation model of particular teaching thinking efforts which includes: (1) a scope and sequence of clearly defined thinking operations arranged in a developmental, integrated sequence at three levels (grade levels, subject areas, and within subject areas); (2) the use of an instructional framework and teaching strategies that provide explicit instruction; (3) explicit, school-wide attention to the attitudes and dispositions that drive skillful thinking; (4) provision of a support system and staff development training; (5) an assessment program for both students and the program itself; and (6) continuing revision of the program.

Sternberg and Bhana (1986) maintain that evaluations of most of the major teaching thinking programs show mixed results, at best, in reporting the extent to which these efforts are effective instruments of increasing students' cognitive skills. They also raise an important distinction between evaluation of the effectiveness of a program <u>per se</u> and the quality of the implementation of such a program in terms of its original design. In selecting a promising thinking program, says Sternberg (1985), educators

should look for at least the following characteristics:

- The program should be based on a psychological theory of the intellectual processes it seeks to train and on an educational theory of the way in which the processes will be taught.
- The program should be socioculturally appropriate ... for the student populations for whom it is targeted.
- The program should provide explicit training both in the mental processes used in task performance and in self-management strategies for using these components.
- The program should be responsive to the motivational as well as the intellectual needs of the students.
- The program should be sensitive to individual differences.
- The program should provide explicit links between the training it provides and functioning in the real world.
- Adoption of the program should take into account demonstrated empirical success in implementations similar to one's own planned implementation.
- The program should have associated with it a well-tested curriculum for teacher training.
- Expectations should be appropriate for what the program can accomplish (pp. 185 - 186).

Implementing a thinking skills program in the classroom is not such a simple task. One does not just "plug in" a ready made remedy. Careful thought and evaluation must go into the selection task and evaluating the results of an implementation depends, to some extent, on how faithfully a given application has been true to the original design of the developer. How does this realization play out in the realities of genuine school applications for teaching thinking? How do current, available "programs" relate to the four frameworks presented in the historic review at the outset of this study? It is proposed that examining a selection of the teaching thinking programs in terms of these issues will help educators better understand what they are trying to do in the overall goal to teach thinking. That examination is the focus of the next section of this study.

Three Programs for Teaching Thinking

American school administrators face a supermarket of teaching thinking programs and have to select one for their student populations in terms of many differing factors. Hypothetically, this examination proposes that three exemplary "programs" could be the subject of such a selection for urban school leaders concerned with curricular decision making for both elementary and secondary schools. The three such programs proposed as candidates are: Reuven Feuerstein's Instrumental Enrichment (IE) program, Stanley Pogrow's Higher Order Thinking Skills (HOTS) program, and Robert Slavin's Cooperative Learning program. Both IE and HOTS advocate they are interventionist teaching thinking programs; Slavin's approach to more thoughtful instruction in the classroom does not make that claim, but in effect seeks to construct the learning environment by means of which better student thinking is actively developed. All three programs are suggested as effective for students who have learning difficulties and, in each case, have been developed for urban, at-risk populations in American elementary and/or middle schools.

Instrumental Enrichment (IE). Feuerstein's IE is the program with the longest history and the largest base of application at sites around the world (Link, 1985). Originally aimed at improving the overall cognitive performance of low-achieving adolescents (generally age 10 and older), IE has been used with a variety of populations and at numerous kinds of institutions serving both children and adults. There are six major goals of IE:

- To correct weaknesses and deficiencies in cognitive functions.
- To help students learn and apply the basic concepts, labels, vocabulary, and operations essential to effective thought.
- To produce sound and spontaneous thinking habits leading to

greater curiosity, self-confidence, and motivation.

- To produce in students increasingly reflective and insightful thought processes.
- To motivate students toward task-oriented abstract goals rather than toward objectives of impulsive self-gratification.
- To transform poor learners from passive recipients and reproducers of information into active generators of new information (Link, 1985, p. 90).

Feuerstein sets out to change the very cognitive stucture of the students brought into his program and his theory of cognitive modifiability proposes that the program is based on a sound interpretation of how such change can take place. Youngsters who are "at-risk" or who show serious cognitive function deficits are "retarded performers," says the Israeli clinician; they have been "mediationally deprived," and the instruction provided through the intervention program developed by Feuerstein and his collaborators seeks to make up for the students' demonstrated disability at being able to learn. In implementing IE in the student's curriculum, Feuerstein proposes to help educators assist students in mastering cognitive operations that can make them mentally independent (Feuerstein et al, 1985).

Two key aspects of Feuerstein's program are the mediating role of the teacher or instructor and the materials that are used to instruct the child. Mediated Learning Experience for Feuerstein "is the kind of interaction in which an experienced intentioned adult interposes himself or herself between a child and some external stimulus and alters the stimulus prior to its perception by the child" (Feuerstein et al, 1985, pp. 46-47). Mediated learning also involves the mediator interposing himself or herself between the learner and the child's response to stimuli; eventually, as the child's concepts change, there is a growing reliance on verbal and symbolic representations. The tool which Feuerstein and his colleagues interpose

into a student's curriculum includes 14 units of classroom tasks which in IE are called "instruments." By studying these instruments, interacting with the mediational adult and others in the classroom environment, retarded performers learn to reconstruct their mental processes and build the skills of better cognitive functioning that can be applied to tasks beyond the specific instruments.

The IE program requires every practitioner who is going to use the materials to be trained in the theory and practice of mediated learning instruction. First year instruments, including Organization of Dots, Orientation in Space I, Comparisons, and Analytic Perception, are studied in three or four days of staff training. The program is not intended to replace traditional curricula but is expected to be used as a cognitive supplement to the regular course of study. Teachers and students are expected to create "bridges" to both specific and general subject areas, as opportunities arise in teaching the particular instruments (Link, 1985). Through the course of teaching IE, teachers can be supportively assisted in understanding the further theoretical aspects of the program, the multiple criteria of mediated learning experience, and Feuerstein's vision of a cognitive map. Use of advanced instruments requires another three or four days of staff preparation, generally followed by ongoing in-service and technical assistance sessions with teachers in order to analyze what is happening in a particular implementation and to find out how to improve it.

The research on IE has been extensive and involves a variety of both American and international experience. Link (1985) reports that in 1982-1983 studies performed on the program's results were guided by three major questions: (1) To what extent did students improve their reading and mathematics skills? How do reading scores of IE students compare with

randomly selected non-IE, nonpublic school students receiving remedial reading or mathematics services? (2) To what extent do students have positive attitudes towards the IE program? and (3) Was the program implemented according to the training received? What were teachers' attitudes towards the availability, comprehensibility, and continued use of IE materials (p. 102)? She concludes that studies at that time show that IE had been successful in terms of student achievement, students' perception, and teachers' perceptions -- "substantial gains" were made and teachers were enthusiastic. In addition, she concludes, observations in classrooms gave evidence that the teachers' performance generally adhered to the developers' program design.

Sternberg and Bhana (1986) report that their review of IE's international implementations shows a wide variety of investigators working with the IE program with diverse subject populations with respect to country, social class, age, intellectual level, and educational level. The dosage of program use varies, too, and the Yale researchers maintain that greater amounts of exposure generally lead to greater gains, particularly of an academic variety. As they see the IE intervention as a "non-verbal experience," Sternberg and Bhana expect that aspects of students' abstract reasoning and spatial visualization are especially influenced by studying IE. One particular lacking in the IE research, they suggest, is information on constructs of insight and motivation, which are specific program goals. In general, Sternberg and Bhana seem particularly hopeful that IE is an appropriate selection for teaching thinking to students of average or below-average ability at the junior high school level of schooling.

A more recent implementation of Feuerstein's IE program was conducted in Somerset, England, and reported in a publication by Blagg (1991). Mixed

results, similar to those found by Sternberg and Bhana, are reported in this study, particularly with regard to IE's cognitive effects on students. Blagg notes difficulties in tracing the ability of IE instruction to increase the likelihood of transfer to other areas of the curriculum. He also cites the problem of identifying appropriate evaluation instruments by which to test an innovative instructional model. What is interesting in this extensive British study is that Blagg suggests students did show a greater consciousness or awareness of their own cognitive abilities and, even more strongly stated, that teachers were clearly influenced by learning about and teaching Feuerstein's particular thinking development program (p. 137). These are not trivial outcomes. At the same time, the British study shows there are quite a few unanswered questions about teaching thinking programs in general, and many specific issues of implementation and evaluation that still need to be sorted out.

Higher Order Thinking Skills (HOTS). Stanley Pogrow's HOTS program for teaching thinking was developed at the University of Arizona and validated by the National Diffusion Network, an agency affiliated with the Office of Educational Research and Improvement in the U.S. Department of Education. HOTS is generally recommended for Chapter 1 students, those designated as having particular learning difficulties and quite often disadvantaged backgrounds, in grades 3 - 7 of the elementary school. It has also been used by regular academic students and even gifted populations in grades K - 2. It has been implemented in several hundred schools in the United States over the past five or six years (HOTS, 1990).

The major goal of the HOTS program is to use higher order thinking activities to improve basic skills and social confidence, while improving problem solving ability (Pogrow, 1985). HOTS is designed as a "pullout"

program which needs to be taught 35 - 40 minutes a day, 4 days a week, on an ongoing basis. In effect, the HOTS program becomes the compensatory treatment for the student with learning difficulty. Students should ideally be kept in HOTS for two years, even if they test out at the end of the first year. During the second year, Pogrow recommends five HOTS sessions per week. The problem solving skills in the program are characterized as information processing skills and include metacognition, inferring information from context, decontextualizing or generalizing information, and information synthesis.

HOTS uses commercially available computer programs as a major source of general thinking content. A list of recommended programs is provided to the schools and school districts who have opted to use the HOTS program. Many of these software programs are already available in elementary schools. The HOTS instructional manual includes directions on how to use the computer materials to support the general learning objectives of the program. HOTS expects reading and mathematics studies to be included in every student's course of daily study, in addition to the computer-supported lessons in thinking improvement. The program maintains that any curricular area can actually be used in a substantive relationship with the cognitive materials.

One of the key ingredients of the HOTS program is an outstanding teacher to start with. Pogrow says the HOTS program can be effective only if an outstanding teacher is assigned to work with the materials. This is primarily because he sees the instructor's Socratic-like dialogue as the key measure to help students understand what it means to think. "Learning in HOTS comes from the sophistication of conversation between student and teacher -- not from the computer or the software" (HOTS, 1990, p. 5). Pogrow cautions districts not to draft teachers to work with the HOTS

program, but rather to provide an opportunity for prospective instructors to become interested in the program by having them visit a site or talk with current HOTS practitioners. A weeklong workshop prior to implementation is provided to HOTS teachers on how to use Socratic techniques -- especially including forms of questioning -- when teaching the program. The HOTS workshop is presented by Pogrow and his colleagues from the University of Arizona or by experienced HOTS practitioners who have used the program with populations of students in their own schools. During the first year of student instruction, HOTS trainers work further with school personnel on how to develop student self-reporting writing skills and how to organize general monitoring techniques.

Pogrow makes the HOTS program attractive to school administrators by outlining for them what they can expect to gain by installing the HOTS program in their schools. Student skill gains will be seen in four areas: developing and testing strategies for the solutions of problems; interpreting computer-generated feedback as to the quality of strategies; integrating and synthesizing information from a variety of subjects to the solution of problems; and generalizing ideas across content areas and computer environments. From research generated in several districts that have implemented the program, Pogrow claims that HOTS students become:

- More confident in their own ability to solve a problem.
- Less impulsive, more willing to disconfirm their initial hypotheses.
- More able to see relationships between and among concepts which were formerly viewed as discrete.
- Able to consider more information at a single time while solving a problem.
- More willing to take risks when approaching problems (HOTS, 1990, p. 4).

In addition, Pogrow maintains that discipline problems virtually disappear in HOTS classrooms (Pogrow, 1987). Finally, Pogrow claims that HOTS students have made "significant greater gains in reading and mathematics," as tested on both standardized achievement tests and on district criterion referenced tests, compared with control groups of similar students (HOTS, 1990, p. 2). Increased student achievement is one of the main characteristics required by validation of exemplary projects in the National Diffusion Network listing. Pogrow submits that implementing HOTS is cost effective for the students and a valuable asset for staff improvement, as well.

Based on findings cited from his program, Pogrow maintains that two assumptions he proposes as the basis of his curriculum hold true. First, he suggests that most compensatory (Chapter 1) students are really quite bright and can and should be challenged intellectually. Second, he holds that the key to improving thinking ability is to increase the repertoire of strategies available to students and to increase the ability to develop sophisticated networks of associations between concepts. He blames many of the ills of modern society for conditions not supporting the challenge of these students in their home life:"Passive learning from TV, combined with decreasing conversation in the home, means that students often start the schooling process without having had the process of systematic problem solving modelled for them through interaction with adults (Pogrow, 1987, p. 2). This becomes a particular difficulty for some students after the primary grades at school, when the concepts of learning become more complex and when mere mimicry and fact accumulation no longer serve major curricular tasks.

Independent research on Pogrow's HOTS program is limitedly available.

A study completed at one state university regarding a two year implementation of HOTS in a rural school district of that state showed modest positive results from the program (McClure, 1990). HOTS students in grades 4 - 6, when compared with control groups of youngsters in the same school, showed gains in the Total Battery and the Total Mathematics sub-scales of the Stanford Achievement Test. No significant gains were reported on the Reading sub-scales. Positive scores regarding reasoning ability were shown for HOTS students in only one section, Section IV, of the Ross Test of Higher Cognitive Processes. On the Blog Test for Inference, a test recommended by Dr. Pogrow, HOTS students showed an enhanced ability to make cognitive inferences. Mc Clure states that "The HOTS students made more guesses than the comparison group and seemed to be more willing to modify their guess to account for more information. Furthermore, HOTS students offered more disconfirming statements than non-HOTS students" (p. 5). On the Coopersmith Self-Esteem Inventory, the HOTS students made significant increases in self esteem. Interestingly, Mc Clure noted that a separate investigation of all the teachers in the study showed that sixth grade HOTS teachers asked many more higher level questions than the other teacher groups. It seems that a major funding organization is encouraged by general results from HOTS, as the program is being funded in numerous urban school districts across the United States. Interest in HOTS seems high, as well, among districts that are able to fund their own staff improvement efforts. Results from such implementations are eagerly awaited by the research community.

Cooperative Learning. The third example of a teaching thinking intervation is drawn from the innovative instructional practice of cooperative learning, a field of laboratory research in social psychology

that dates back to the 1920's (Slavin, 1980). Over the past ten to fifteen years, programmatic applications of cooperative learning instruction in American elementary and secondary schools have focussed on studies of student achievement for both cognitive and affective goals (Newmann & Thompson, 1987). It has generally been accepted that when students have to organize their thinking to explain ideas to their classmates, they need to engage in cognitive elaboration that greatly enhances their own understanding of a subject or topic (Dansereau, 1985).

Two particular applications of cooperative learning have been developed by Robert Slavin and his colleagues at the Center for Research on Elementary and Middle Schools (CREMS) at the Johns Hopkins University in Baltimore. Cooperative learning for Slavin "refers to a set of instructional methods in which students work in small, mixed-ability learning groups" (Slavin, 1987, p. 8). Slavin includes three types of instructional structure in cooperative learning lessons: task structure, reward structure, and authority structure. Learning tasks are designed around specific contents and particular cognitive skills related to that content; rewards for accomplishment are keyed primarily to team or cooperative behaviors -- although testing is by individual student performance -- and a high degree of student autonomy is sought, particularly with regard to management of curricular materials, checking individual student's work, and routing assignments for the team's completion.

The two specific interventions developed and tested by Slavin and his associates are Team Assisted Individualization (TAI), an elementary mathematics curriculum consisting of lessons on a wide range of activities from basic computational arithmetic to introductory algebra, and Cooperative Integrated Reading and Composition (CIRC), a language arts program including

self-instructional materials on reading, writing, vocabulary development, and spelling. It is useful to describe Slavin's approach in each of these classroom applications, which he views as the basic, necessary curriculum for grade 3 - 6 youngsters. In TAI, students work on individualized mathematics lessons, many set in word problem formats, beginning where a diagnostic test indicates the youngsters can be successful and learn. Teachers provide carefully focussed instruction on the particular conceptions or cognitive operations of the mathematics lessons, and students through team assignments assist one another in checking skill practice exercises or explaining discrepancies. Slavin is particularly interested in mainstreaming Chapter 1 or low achieving, disadvantaged students in the mathematics program. He suggests that these youngsters be placed in groups with only four or five members and that two or three of the teammates be average to high achieving pupils.

There is a careful tracking of achievement through the pursuit of the TAI materials. Teachers intervene with specific instruction on mathematics conceptions and teams monitor and self-correct their members, as each curricular segment is mastered. Certificates of accomplishment are issued as teams achieve their group goals. Every three weeks, the TAI teacher stops the individualized instruction and spends a week teaching the whole class particular conceptual aspects of geometry, measurement, sets, and problem solving strategies (Slavin et al, 1989-90).

CIRC consists of three principal elements: basal-related reading, direct instruction in reading comprehension, and integrated language arts/writing. Students work in heterogeneous learning teams, as in TAI. Assignment is by reading level, as determined by the teacher, and -- while every student has a parallel skill partner -- teams consist of students who

demonstrate varying levels of competence. Slavin includes the school's own reading material in the basal segment, but teachers in CIRC "are taught to use a vocabulary presentation procedure that requires a demonstration of understanding of word meaning by each individual" (Slavin et al, 1989-90, p. 26). Other strategies teachers are prepared to use in the program involve methods of word attack, meaning analysis in content, and making and supporting predictions. At the end of a story, students are required to summarize it and then check each other for essential story elements. Vocabulary and spelling mastery are related to a particular story and students practice writing sentences correctly while using new vocabulary words drawn from the story and in the context of the story line.

One day each week, CIRC students receive direct instruction from the teacher in reading comprehension skills by means of a specially designed curriculum that emphasizes finding main ideas, drawing conclusions, and comparing and contrasting ideas in the reading selection. CIRC students also pursue independent reading both at school and at home. Along with specially assigned book reports, this independent reading constitutes all the students' homework assignments in language arts (Slavin et al, 1989-90).

Research studies on these cooperative learning programs have been completed mainly through CREMS-supported investigations. Slavin et al, 1988) maintains that when the TAI teams were rewarded, based on the individual learning of all team members, the cooperative learning approach proved to be consistently effective in increasing student achievement, as compared to control group students taught mathematics with traditional methods. Subsequent studies indicate that equally positive results on TAI were obtained for high, average, and low achievers (Slavin et al, 1989-90). Recently, positive results have also been obtained on two major CIRC studies

(Madden et al, 1986; Stevens et al, 1987). In the first study, in terms of reading comprehension and vocabulary, CIRC classes gained 30 to 36 percent of a grade equivalent, 52 percent in language expression, and 72 percent more in spelling, when compared with control group youngsters. In the second study, scores of CIRC students on the reading comprehension, language expression, and language mechanics sections of the California Achievement Test averaged gains of almost two-thirds of a grade equivalent, as compared to control group youngsters. Reading vocabulary gains were not significantly better for CIRC students in the second study, but an informal reading inventory added to the evaluation showed much better performance. Slavin and his associates point out that although the CIRC program shows equal gains initially for high, average, and low ability group youngsters, mainstreamed academically handicapped (Chapter 1) students made particularly impressive gains (Slavin et al, 1988).

In general, both TAI and CIRC seem to enhance youngsters' ability to construct knowledge while, at the same time, helping students to become more responsible for their own classroom management. Such cooperative learning interventions also seem to improve the self-confidence of students, giving them greater opportunity to become proficient in learning tasks within a more user-friendly classroom environment. In addition to work in mathematics and language arts, cooperative learning recently has also become a curricular model for elementary science instruction (Okebukola, 1985; Hannigan, 1989-1990).

Learning from Teaching Thinking Programs

The varied applications of teaching thinking interventions tell us a great deal about the goals of the teaching thinking movement. Even with a focus on youngsters who are harder to teach than others, the review of

Feuerstein's, Pogrow's, and Slavin's efforts to help youngsters with learning difficulties in elementary and middle school curricula shows that much can be done that is effective academically and socially. The review shows that all the thinking approaches are not the same and that, while various issues are raised by such an examination, other contentions of the teaching thinking movement are also confirmed. What can be learned about the four frameworks for teaching thinking that were suggested at the outset of this study?

All three of the exemplary programs confirm the proposition that all children are intelligent beings who can benefit from positive learning experiences. Children at a similar age are not necessarily on the same footing with respect to cognitive abilities and the different learning tasks in content areas, but various materials and alternative classroom organization schemes help youngsters experience a variety of responses that can positively influence their mental understandings. Not only is the learner's malleability important, but so is the teacher's grasp of a student's intellectual functioning. A clear understanding of the cognitive operations students need in particular contents to be learned, as well as a strong grasp of what the teaching thinking program developer intends in their curricular efforts, are just the beginning steps of introducing thinking successfully in the classroom.

The importance of learners constructing their own understanding is evidenced in all three of the interventionist programs reviewed. Developing thinkers need to know what thinking is, as well as be aware of when, how, and why a classroom experience is meaningful to a learning task. The three intervention programs reviewed all seem to include activities by which youngsters gradually learn to be responsible for their own performance,

either independently or in teams. At the same time, students interact in various ways with teachers so that cognitive understandings are much more succinctly grasped. The environment for learning in such a thinking classroom is a conscious factor that influences the autonomy of the learner in each of these experimental programs. Ability to question, respect even for mistake-making, and goals for long-term learning are aspects of user friendly classrooms that were conveyed in all three of the interventions. Active involvement of the learners and engagement with specific materials in meaningful and challenging ways were characteristic of all three programs, albeit for different goals in the three examples.

The important role of social exchange in learning was significant in all three programs. Feuerstein's IE emphasizes the teacher's mediating role above all other interactions; Pogrow's HOTS program stresses both teacher and peer influence, and also introduces computer usage in the classroom; and Slavin's cooperative learning initiatives involve various ability level students' team-based exchanges in addition to teacher instruction. But all three interventions mandate that learning to think is a reciprocal, social operation heavily dependent on lively interaction. Thus, curricular tasks need to be created to serve such reciprocity, and programmatic thinking activities or materials become instruments or tools which provoke memorable mental responses on the part of learners. The precise use of language and meaning, the careful representation of cognitive concepts in the instructional materials -- tied to subject matter content and particular student referrents -- are the foci around which all three interventions center. It is anticipated that these indelible learnings transfer to more long range cognitive outcomes as students progress through the various interventions.

Finally, information tracking is a long term outcome of learning to work with these three intervention programs. Feuerstein sees the fourteen IE instruments as generic building blocks for all the student's higher level processing. Pogrow uses the computer analog of problem solving as a general approach to learning, suggesting Socratic techniques as a specific way to talk about both the nature of a problem and the requisites for successful solution. Slavin and the researchers in cooperative learning see the competence built by team interaction and the involvement of all students in the class activity as the entree behaviors for dealing with specific aspects of information embedded in problems of mathematics or language arts. When the environment is user friendly and supportive, when minds can be open and keyed to strategies for unearthing new and needed data, the natural curiosity of the student wins out and leads to successful learning. By contrast, it is presumed that negative, competitive systems close down the learner's ability and ultimately result in withdrawal and failure. Interventionist programs, it seems, by their very nature are positive systems for learning.

IMPLICATIONS FOR IMPLEMENTING THINKING IN THE CURRICULUM

Based on the limited investigation of this study, it seems the first question raised in this examination can be answered strongly in the affirmative. There are thinking programs that have shown they can make a difference in children's cognitive learning experience at school. But Feuerstein's IE, Pogrow's HOTS, and Slavin's cooperative learning initiatives are only three of the interventionist models that have been developed and tested over the past ten to twelve years in the United States. Other studies show that there is a general acceptance that higher level skills can be purposefully planned for and taught in the school's curriculum (Haller et al, 1988). Fewer studies examine the question of how a school or district can support and facilitate a sound implementation of such programs.

Anyone who has worked with practitioners in introducing a new approach or method knows there is often initial resistance to change and a certain amount of anxiety on the part of participants. There is no difference when it comes to teaching thinking efforts. The first question often raised is "Haven't teachers been teaching thinking all the time?" Other conditions created by practices and policies already in place in schools may actually create barriers to developing thoughtful classrooms. How can the new intervention programs deal with these difficult situations?

Levine and Cooper (1991) list a number of factors that need to be considered when the implementation of change is considered with teaching thinking innovations. At least six of their factors seem to be significant in considering the interventions examined in this study. A discussion of these factors forms a general conclusion not only about specific thinking

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programs, but relative to the long range meaning for the teaching thinking movement in general.

Clarity of Objectives

The extent to which all participants understand and support the objectives of an innovative program can significantly influence outcomes. These objectives need to be shared and spoken about frequently. Preparation before implementation can be crucial to a teacher's understanding about a program, the realization that such an innovation influences not only current practice in the classroom but curricular and instructional development in more generic ways. Similarly, administrator understanding of the objectives of a program needs to be in place early on in an implementation, both for administrative considerations like budget and personnel allocation and for such purposes as planning staff development, organizing schedules, communicating with parents and district or state officials, and coordinating assessment practices.

One of the striking observations about the three programs reviewed in this study is that they all concentrate their goal statements on student change. Self-regulation and building learner autonomy, along with content mastery, are often emphasized in descriptions of the programs. Even so, it could be said that one of the major outcomes of these interventions was how they influenced changes in teacher behavior. In the context of the current interest in America for "restructuring" schools, appreciating both the student and the teacher goals of programs for teaching thinking may be a significant way to promote "a vision of the school as a learning community" (Owen et al, 1991). For students at risk, for example -- addressing one of the most vexing problems of industrialized societies all over the world -- a goal to understand fully Feuerstein's Mediated Learning Experience may be a

measure of the educational complexity of really addressing this population's need in any classroom.

Importance of Environment

A second factor of implementation hinges on the significance of the sites in which a program will be conducted, the particular populations of that location that are the target groups of the innovation, and specific characteristics of each unique environment. What history has this site had as a change agent organization? What other innovations have been conducted here or are being conducted at the same time as this teaching thinking program? What are the particular needs of this urban, minority population or a group of immigrant, culturally different students? All these concerns may be issues that innovation planners need to consider.

The three programs reviewed in this study each try to prescribe the kind of setting that they think would be an ideal location for their particular program. However, to some extent, success in using an innovation hinges on the individualized tailoring that occurs when well prepared practitioners create situations that make the best use of the programs with their particular students. Limits of students' ability to benefit from a program ought to be understood by the various teachers working with those students and the intervention materials. Planning simultaneous activities that will reinforce a program beyond a single classroom calls for collaboration and sharing that is much greater than a maverick teacher working alone with cooperative learning. In short, the environment of the school in which one of these programs is being implemented is key to the support of the whole program, just as a particular classroom becomes the expression of the innovation for any given group of students.

Staff Development and Program Support

Although each of the implementations reviewed described the training for teachers required by that program, it becomes fairly evident that such training in and of itself is not sufficient for the changes called for by the teaching thinking program goals. Actually, this is no surprise. Teaching thinking programs are not "quick fix" operations that a teacher can learn in a one-time workshop or a single staff development session. Longer, more sustained preparation is very desirable, perhaps advisable, to insure the success of a programmatic effort. Even more important, it seems that programmatic support in the regular supervisory and substantive development aspects of curriculum and instructional improvement in the school district should really be encouraged and raises some considerations for thinking program developers to examine.

A case in point on this topic is the development of staff preparation in the innovative and preventive reading program for primary children, Reading Recovery, developed by Marie Clay and her associates in New Zealand. Gaffney (1991) points out that Reading Recovery is not a method of teaching, an instructional package, a prescriptive program, nor a commercial kit for beginning readers. It is a way for a system to intervene in the first grade classroom for the purpose of preventing reading failure in a population of students who have been identified at-risk of that condition. At the same time, and parallel to many of the teaching thinking innovations, Reading Recovery helps teachers to see their primary task of mediating literacy as a complex thinking operation. The full year of clinical training and classroom case study mandated by Reading Recovery shows the seriousness this innovation requires for staff development. Like IE, Clay and her associates

have the concern of keeping their treatment at a high level of quality. They, too, carefully coordinate their trainers around the world for program control. Universities that are preparing Reading Recovery teachers have the support of granting credit and collecting tuition as aids to their preparation of program staff. The staff development model they use may give the teaching thinking programs food for thought with regard to how they establish training and powerful program support both within a district and beyond it in the teacher education world.

Incentives for Involvement

Implementation of a teaching thinking effort needs to be concerned, too, with why educators would want to become part of an innovation and have sustained energy to stay so committed. Pogrow suggests that only very able, motivated teachers be involved in his HOTS program. Can a school or district do anything to help the teacher quality situation or the motivation of their staffs? It seems that being involved in learning more about teaching thinking programs is to keep abreast of the latest developments in educational improvement. In discussing the importance of computers in restructured schools, Collins (1991) suggests that challenges in the new world of schooling involve a shift from the primacy of verbal thinking to the integration of visual and verbal thinking. Such issues lie at many of the instructional concerns in the new thinking programs. Similarly, Perkins (1991) points out that careful synchronization of difficulty in learning tasks has to be worked out for the proper conflict to be developed in instructional materials, while students simultaneously consider and converse about the materials -- issues very central to coordinating Feuerstein's instruments with other classroom assignments and creating the necessary bridges to disciplinary content.

Involvement of larger entities than teacher groups in innovative programs ought to be considered in implementations, too. What role does the central staff of a district play in installing innovative programs? Should the principal be trained in a program or the curriculum coordinator, who also may play a role in the ongoing program support structure? In the United States, the importance of assessment practices to program evaluation is a major concern, as well, as student success will inevitably be translated into scores on district, state, or national tests. There is a strong current of community involvement developing in American schools, too, so that program implementation may need to attend to the interests of parent groups, business and community organizations, and labor unions in their depiction of the particular thinking program and what its implementation may mean for any group of students and teachers.

Timing and Ownership

Issues about timing in implementing thinking programs can be discussed from how long does a curriculum provide for working with the innovative intervention to how long do you wait for results to be documented and verified. Quick fixes expect results in a very short time. Pogrow (1991) maintains that the HOTS pullout model needs at least two years before definitive results can be anticipated. Time with regard to teacher preparation considerations also turns into budget concerns that may require additional funding, changes in union staffing agreements, and material costs over a whole year or multiple years. Implementations of a major program cannot ignore these issues and it is important that they be discussed and settled before the instructional personnel are even involved in programmatic change.

Who owns an innovation is another concern that may be related both to

the fiscal considerations of an implementation and to the leadership decisions about school reform or improvement. It is not wise to mandate change solely from the top, as years of school effectiveness research have informed us. Similarly, grass roots interest is generally not commitment enough to sustain a long term implementation, nor to fund it. Ideally, all the parties of a school or school district should have a role in implementing a new effort and in making phases of the implementation real and effective. In these days of school based-decision making, discussing how students can become more thoughtful and classrooms more cognitive may be a happy basis for beginning such an implementation.

Stable Leadership

Perhaps no factor is more important to an innovation than who leads the effort and coordinates the interested constituencies. It is no accident that each program reviewed is associated with a researcher or a developer who has spearheaded that program for a considerable period of time. At implementation sites, singular leaders or groups of interested staff need to take on the responsibility and the role of guiding that effort. The research literature is full of examples of innovative projects that failed due, at least in part, to the instability in leadership at the district or school level (Levine & Cooper, 1991). This is all the more serious because significant innovations take a long time to introduce, conduct, and refine. Where preparation is thorough and intensive -- and thus costly, as Reading Recovery indicates -- the demands on the innovative leader may have to be translated into more permanent conditions. Numerous studies exist regarding the skills of an able building leader or the style of a project manager. Developers of implementations in teaching thinking may well want to examine these materials and consider how that knowledge might influence the ways

they represent their programs and the expectations they have for program adoption.

In Conclusion

This study has found that there are numerous successful programs that are available for teaching thinking. The research results from these programs are promising but not overwhelming and, obviously, more coordinated research is needed. Studies by independent researchers, separate from the major developers, are sorely missing. More specific studies of what works in any of these programs for which particular students instructed by it are also in need of completion, especially with the global use of many of the thinking programs. For example, IE has been translated into fourteen languages and other programs, like Philosophy for Children and CoRT, also have international implementations. More specific studies of what able teachers using these programs do to make the innovations successful are also needed.

This study also found there are many aspects of implementation that need to be examined in order to understand fully what it means for an innovative thinking program to be successfully installed. Too few studies of the programs in the teaching thinking movement have been subjected to rigorous applied research. Let us hope that the dialogue generated in a conference such as this will inspire some of this much needed examination to be initiated.

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ABSTRACT

IMPLEMENTING THINKING IN THE SCHOOL'S CURRICULUM

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Overview

The emergence of a new paradigm for education, "the cognitive revolution," has led to an advocacy for teaching of thinking -- building competence and sophisticated, self-regulative patterns of thought -- in the schools.

This three-part study (1) explores the theoretical and research foundation of the teaching thinking movement in historical context, (2) describes the classroom programs that reflect the research foundation and interventionist approach to teaching thinking, and (3) discusses the factors that lead to successful implementation of thinking programs.

The Research Foundation

The advocacy for the teaching of thinking became a legitimate and conscious effort in both American and European schools after several decades of psychological and sociological research on cognitive development. Insights from this research which can be applied to the teaching of thinking are examined from four perspectives or frameworks:

- The Cognitive View of Intelligence
- The Constructivist Approach to Learning
- The Social Psychological View of Classroom Experience
- The Perspective of Information Processing

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Exemplary Thinking Programs

Three programs which illustrate exemplary teaching strategies and can be linked to the four research perspectives include:

- Instrumental Enrichment (IE), developed by Reuven Feuerstein
- Higher Order Thinking Skills (HOTS), developed by Stanley Pogrow
- Cooperative Learning (TAI and CIRC), developed by Robert Slavin

Findings from the study of these exemplary programs confirm the proposition that all children are intelligent beings who can benefit from positive learning experiences built around a clear understanding of the research base.

Implications for Successful Implementation of Programs

School districts and schools can support and facilitate the implementation of thinking programs by attending to six critical factors:

- Clarity of Objectives
- Importance of Environment
- Staff Development and Program Support
- Incentives for Involvement
- Timing and Ownership
- Stable Leadership

PART ONE: FOUR RESEARCH PERSPECTIVES

A half-century of research on cognitive development preceded the "cognitive revolution" which led to an advocacy for teaching thinking. This research, much of it emanating from Piaget and his conceptual followers, suggests that cognitive development is a complex process, with many simultaneously operating changes. The questions raised in this body of research are central to an understanding of how teachers can best enhance children's thinking.

- The Cognitive View of Intelligence

  Intellectual ability can be changed. Rational thinking is fostered by enhancing one's knowledge base in creative, meaningful ways. Instruction becomes the major vehicle for changing intellectual capability.

- The Constructivist Approach to Learning

  Children actively and independently construct knowledge by creating and coordinating relationships in their own mental repertoire. Learners build their own skilled intelligence by revising their explanative strategies and taking on more complex routines.

- The Social Psychological View of Classroom Experience

  The learner is an individual within peer groups and a member of the larger society. Other persons play an important role in a student's cognitive development and provide a life-long dialogue for learning created through social interaction. Optimal classroom learning environments include proactive information, and the feelings, dispositions, and lively models of cognitive strategizing that support learning.

- The Perspective of Information Processing

  Cognitive change occurs through the acquisition, elaboration, and management of information. The learner is confronted both with recalling important facts or concepts and with knowing what to do with information that is part of working memory. Schooling must pay attention to all modes of information, including new electronic learning environments.

PART TWO: EXAMINATION OF THREE THINKING PROGRAMS AND THEIR IMPLEMENTATION

- Selected criteria of sound teaching thinking interventions
- Four frameworks applied to exemplary instructional programs.

PROGRAM ONE: Reuven Feuerstein's Instrumental Enrichment

GOAL: To improve cognitive performance of low-achieving 10 - 13 year old students by increasing the students' ability to learn and to think.

METHODS: To develop mediated learning experiences for students through use of material tool (IE) and the psychological intervention of an instructor in specified interactions with learners, approximately 3 - 4 hours per week.

To provide key staff development so that teachers are able to use the IE program and to mediate student learning experiences in supportive classroom environments.

OUTCOMES: Improved student achievement, student perception, and teacher perception, according to program goals, reported in several studies. Mixed findings in other international implementations. Calls for more extensive, longitudinal research on program implemented at various sites, and preferably, with different populations.

PROGRAM TWO: Stanley Pogrow's HOTS Curriculum

GOAL: To use higher order thinking activities with middle school students, to improve basic skills and social confidence while improving problem solving ability.

METHODS: To provide pull-out instruction, 2 1/2 - 4 hours per week, of information processing skills using a computer experience as a discussion base, including specific mathematics and reading lessons for middle school children.

To involve able teachers in the program voluntarily and to provide them training in Socratic-like dialogical classroom instructional techniques.

OUTCOMES: HOTS program data available from several districts show positive results in student confidence, lowered impulsivity, identifying connections/relationships, ability to handle multiple sources of information, more risk-taking behavior, and better discipline. Program also shows gains in reading and mathematics achievement.

Limited data available, however, collected by external, independent agency or research organization.

PROGRAM THREE: Robert Slavin's Cooperative Learning

GOAL: Improved learning in particular content areas through cooperative or team implementation with high student autonomy.

METHODS: To instruct low-achieving elementary students in mathematics through Team Assisted Individualization (TIA) and language arts instruction for the same age group with the Cooperative Integrated Reading and Composition Program (CIRC).

To develop small student teams of varying abilities, to track and reward student correct response carefully.

To prepare teachers to use select instructional techniques considered important to student success in mathematics and reading.

OUTCOMES: Improved student achievement in content areas, particularly for mainstreamed academically handicapped youngsters. Increase in personal responsibility for learning also exhibited by youngsters. Personal responsibility for learning by youngsters also increased. Limited research by outside evaluators; more extensive studies in progress.

FINDINGS

1. Programs confirm the proposition that all children are intelligent beings who can benefit from positive learning experiences.

2. Not only is the learner's malleability important, but so is the teacher's grasp of a student's intellectual functioning.

3. A clear understanding of the cognitive operations students need in particular contents to be learned, as well as a strong grasp of what the program developer intends, are just the beginning steps of implementation.

4. It is important that learners have the opportunity to construct their own understanding of the program tasks and become responsible for their own learning.

5. The environment for learning is a conscious factor that influences the autonomy of the learner in each program.

6. The importance of social exchange and instruction in learning is a significant factor in all three exemplary programs; the exchange particularly centers on cognitive issues of instruction.

7. A long-term approach to learning and achievement is presumed in the three programs; change is gradual and requires as much as two years or more of program involvement to show progress.

IMPLICATIONS

1. The extent to which all participants understand and support the objectives of an innovative program can significantly influence outcomes.

2. Particular site and population characteristics need to be considered and addressed as part of an environment for intervention and innovation, including history, needs, and current working conditions.

3. Programmatic support from a school district's regular supervisory staff and substantive development in curriculum and instruction needs to be allied with an intervention to bring long-term success.

4. Implementations need to be concerned with teacher incentives for involvement with a program and with creating conditions for sustained energy and commitment to an innovation across multiple sites.

5. Implementations should attend to allocation of time, staff, and material resources over a school year, or multiple years, in terms of program ownership and support.

6. Perhaps no factor is more important to an innovation than who leads the effort and coordinates the interested constituencies.

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